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Article

Project-based teaching strategy for university students

Estrategia didáctica basada en proyectos para universitarios

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Abstract

This document presents a teaching strategy based on constructivism and project-based learning (PBL) applied to first-semester accounting students at TecNM-Jiménez. The proposal aims to develop critical thinking, professional skills, and collaborative work through the creation of an innovative product made with regional raw materials and its corresponding research protocol. The methodology used was qualitative and phenomenological. Students integrated knowledge from various subjects, solved real-world problems, and participated in an academic competition. The results show that PBL benefited students by enhancing their critical thinking and helping them generate ideas for creating businesses using products native to the region

Project-based teaching strategy for university students		
Objetives	Methodology	Contribution
constructivist approach project based learning socio-emotional and professional skills	Qualitative research encompasses phenomena, explores them in a natural environment and in relation to the context of the participants. It is descriptive, as it specifies the properties, profiles and characteristics of people and subjects them to analysis.	The teaching strategy implemented in the research fundamentals course was well received by the students. The course was conducted in a very dynamic manner, with results that generated academic knowledge and professional and everyday skills. In addition, they had the experience of creating a micro-enterprise, with a product made from local raw materials and strategies for its commercialisation.

Teaching strategy, project-based learning, constructivism

Resumen

El presente documento presenta una estrategia didáctica basada en el constructivismo y el aprendizaje basado en proyectos (ABP) aplicada a estudiantes de primer semestre de la carrera de Contador Público en el TecNM-Jiménez. La propuesta busca desarrollar pensamiento crítico, habilidades profesionales y trabajo colaborativo mediante la creación de un producto innovador elaborado con materias primas regionales y su correspondiente protocolo de investigación. La metodología aplicada fue cualitativa y fenomenológica. Los estudiantes integraron conocimientos de varias asignaturas, resolvieron problemas reales y participaron en un concurso académico. Los resultados muestran que el ABP favoreció a los estudiantes en cuanto a potencializa su pensamiento crítico, auxilió a generar ideas de creación de empresas elaboradas con productos propios de la región.

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Objetivos	Metodología	Resultados
enfoque constructivista aprendizaje basado en proyectos habilidades socioemocionales y profesionales	La investigación cualitativa abarca los fenómenos, los explora en un entorno natural y en relación con el contexto de los participantes. Es descriptiva, ya que especifica las propiedades, perfiles y características de las personas y las somete a análisis.	La estrategia docente implementada en el curso de fundamentos de la investigación tuvo una excelente acogida entre los estudiantes. El curso se desarrolló de forma dinámica, con resultados que generaron conocimientos académicos y habilidades profesionales y cotidianas. Además, adquirieron la experiencia de crear una microempresa con un producto elaborado con materias primas locales y estrategias para su comercialización.

Estrategia didáctica, aprendizaje basado en proyectos, constructivismo.

Area: Development of strategic leading-edge technologies and open innovation for social transformation

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Introduction

Currently, productive and social changes are taking place around the world, and universities are reviewing their teaching practices in order to train professionals who can meet the demands and needs of the world [Barrera et al., 2022]. The way in which people acquire knowledge has also changed. Students learn differently than they did in the past decade, and one of the factors contributing to this change is the modernity of various social networks. As a result, teachers at all levels are faced with the challenge of preparing classes that captivate their students.

Therefore, designing teaching strategies is a daily activity for teachers. For those working at the higher education level, it is recommended that the activities they propose promote critical thinking.

Social needs contribute to changes in government priorities, such that the current 20-30 agenda sets out 17 objectives, which form the basis for education. It is therefore suggested that teaching strategies include projects for students so that they can propose solutions from their perspective. Education has undergone significant changes over time due to its fundamental role in the development and training of individuals and the progress of diverse societies. These rapid changes in the last century that society faces are: technological and scientific advances and globalisation [Ballesteros et al., 2018].

It is advisable for higher education teachers to design their teaching strategies in such a way that students activate their analytical skills, can link theory with practice, and enjoy the activities presented to them by the teacher.
It is suggested that the work proposals developed or designed by higher education teachers as teaching strategies should be dynamic and interesting for the people who are going to carry them out, so that students feel that they are part of their environment and everyday problems, with the aim of learning to resolve the conflicts of today's society and building their learning in a participatory way. "Teaching strategies in education have a great effect on the development of student learning, with positive results that benefit both the teacher and the student [Herrera and Villafuerte, 2023, p.758].

In the same vein, "the teaching strategy developed by the teacher and the tasks and activities that comprise it should encourage students to build their knowledge and take responsibility for developing their skills and socially acceptable behaviours [Zambrano et al., 2022, p. 176].

1. Justification

In today's globalised world, education faces great challenges, with continuous and significant changes transforming contemporary society. In academia, teachers are advised to seek pedagogical methods or teaching strategies that strengthen the development of critical thinking in students, as this type of reasoning enables individuals to analyse, understand and evaluate the knowledge around them in a reflective manner, thus creating a personal interpretation of the world that helps them adapt and perform in the workplace [Ballesteros et al., 2018].

At the undergraduate level, teaching strategies can be prepared for students by linking several subjects with the intention of solving community problems through project-based learning. The final product may be the answer to solving the conflict raised by teachers. ‘One of the focuses of the work carried out by higher education institutions is the search for teaching strategies that promote the development of skills that enable people to live a full life and function in society’ [Barrera et al., 2022, p.278]. This can generate critical thinking in people and help them construct their own learning.

One definition of ‘teaching strategies’ is ‘procedures planned by the teacher with the aim of facilitating student learning through the use of resources, activities and techniques that promote knowledge construction’ [Díaz and Hernández, 2010, p. 140]. In the various subjects taught at HEIs, it is possible for teachers of two or more subjects to develop strategies with the aim of encouraging students to analyse theory and practice.

The subject constructs knowledge of reality, since reality cannot be known in itself, but only through the cognitive mechanisms available, mechanisms that, in turn, allow for transformations of that reality [Araya et al., 2007, p. 77].

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2. Statement of the problem

In higher vocational education, one of the most significant challenges is to ensure that students acquire and develop comprehensive skills that enable them to apply theoretical knowledge and practical application in a critical, creative and collaborative manner in real-life scenarios. However, a large proportion of educational programmes still use traditional teaching methods that limit students' active participation and their ability to generate their own meaningful knowledge.

Even though educational plans and programmes promote student-centred learning, project-based learning and critical thinking, their application in the classroom has been limited. This restricts students' ability to deal with everyday situations that promote decision-making, problem-solving and self-assessment of their own learning.

The definition of learning is 'acquiring knowledge of something through study or experience involves interacting with the environment, experimenting, collaborating and reflecting.' From a constructivist perspective, 'learning means actively constructing knowledge; it is not simply receiving it passively from the environment or the teacher, but elaborating it and integrating it with prior knowledge' [Ausubel, 2002, p. 34]. Project-based learning provides the environment for this.

This strategy allows students to participate in meaningful activities that combine theory with practice and the attitudes necessary for training.

In this sense, a project-based teaching strategy was designed and implemented, based on constructivism and focused on the development of critical thinking, with the aim of positively impacting student training. The intention is to strengthen students' knowledge-building and collaborative work skills by involving them in real-world projects.

According to the syllabus for the research fundamentals course established by the higher education institution, it states that:

The course was designed to contribute to the comprehensive training of students...

It develops research skills that are used for conceptual, procedural, and attitudinal learning contained in the curricula of the educational programmes offered...

It should employ constructivist learning strategies that allow students to achieve skills in analysis and synthesis, strengthen oral and written communication with the support of ICTs, and enable them to identify scenarios for intervention in their professional field [Tecnológico Nacional de México, 2016].

With the aim of making the subject more dynamic and encouraging teamwork, a teaching strategy was designed based on project-based learning that would encourage critical thinking. As a final product, it requires an integrative disciplinary project that involves students in the knowledge of their career and is an important part of their assessment in this subject, which consisted of students developing an innovative product with commercial potential, using products or raw materials from the region and using this information to develop their research protocol.

3. Objectives and research questions

General objective: To design and implement a teaching strategy based on the constructivist approach and project-based learning to encourage the development of critical thinking and professional skills in higher education students.

Specific objectives:

To design and implement a project-based teaching strategy based on the constructivist approach.

Observe and describe the process of developing student projects for the active construction of knowledge.

Evaluate the professional and socio-emotional skills promoted through collaborative work and the resolution of real problems.

Research question:

How does a teaching strategy based on the constructivist approach and project-based learning influence the development of critical thinking and professional skills in higher education students?

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4. Theoretical framework

Teachers design or adapt various activities, known as strategies, for their classes. To this end, 'a teaching strategy is a set of activities planned by the teacher with the aim of facilitating meaningful learning in students' [Díaz and Hernández, 2010, p. 135]. At the higher education level, the planning of assignments should pursue several objectives, including academic transversality and the establishment of solutions to real problems, in order to awaken the capacity for analysis and the theoretical-practical link.

The tasks assigned can be carried out through projects in which students can develop academic knowledge, research skills, social skills, investigative skills, communication skills, among others, in such a way that learning is meaningful and comprehensive.

Teaching strategies are physical and mental activities and functions that facilitate the student's encounter with the goal of knowledge and a relationship of help and cooperation with peers during learning in order to complete the task with the required quality [Ribadeneira, 2023, p. 788].

In the same vein, learning is an active and constructive process in which individuals acquire knowledge, skills, and strategies not only through direct experience but also through observation of others and interaction in social contexts [Bandura, 1986]. According to the above definition, active participation in the teaching strategy will generate learning for those involved. 'Project-based learning is a student-centred methodological strategy that promotes meaningful learning through the planning, development and evaluation of a project related to their reality' [Díaz Barriga, 2005, p. 86].

The application and solution of the project-based teaching strategy can help to enhance meaningful knowledge with real problem solving.

With work planned for students and based on project-based learning, they report that it is a teaching strategy that promotes the active participation of both students and teachers [Barrera et al., 2022, p.279].

When teachers develop academic assignments with various activities for students to carry out and guide them to complete what is requested, this is referred to as project-based learning.

This translates into a way of thinking based on rigorous standards of excellence and a conscious awareness of their application. Critical thinking is self-directed, self-disciplined, self-regulated and self-correcting judgement [Paul and Elder, 2014].

To carry out a student project, students must meet the characteristics described above. They will also develop skills in consultation, research, analysis, problem solving, coexistence, and proposing improvements if the project is in the social sphere. A teaching strategy based on constructivism was established: 'knowledge is not transmitted, it is constructed' [Piaget and Inhelder, 1970, p. 15].

5. Methodology

The research was carried out at TecNM-Jiménez between August and December 2024 with first-semester students studying to become public accountants. Qualitative research encompasses phenomena, explores them in a natural environment and in relation to the context of the participants.

It is descriptive, as it specifies the properties, profiles and characteristics of people and subjects them to analysis. It has a phenomenological approach, understanding the meaning that people experience and giving meaning to their experiences.

It also generates or adjusts research questions through interpretation with collected non-numerical data [Hernández et al., 2014].

The division of labour in the strategy consisted of the following steps: researching processes to develop a product, costing it and calculating its sale price, and finally preparing the research protocol report.

To carry out this work, they linked knowledge from a large number of subjects such as accounting, ethical management, costs, human development, social dynamics, among others.

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With the aim of making the subject more dynamic and encouraging collaborative work, a teaching strategy based on constructivism and project-based learning was designed. This consisted of students developing an innovative product with raw materials from the region and marketing potential, and concluding with the preparation of a research protocol. As part of the process, students had to investigate the procedures necessary for the production process, calculate costs, and establish the selling price of their product.

To accomplish this task, they integrated knowledge acquired in various subjects, which allowed for an interdisciplinary and contextualised learning experience.

To comply with the project-based learning strategy, they formed teams of up to three members, designed an innovative product using raw materials from the region and marketed it, in addition to participating in a local academic competition called 'Rumbo a Expociencias 2024' [Towards Expociencias 2024]. To carry out the task, the work was divided into several stages: generating the idea, researching ingredients for the product, the manufacturing process, marketing, costs, setting the sale price, and developing a research protocol. To support the development of the project, a visit was organised to the Natural Resources Research Centre, where the students were provided with information about the production and processing of some of the products they made, such as banana jam with amaranth, matcha yoghurt, dehydrated fruits and vegetables, and walnut cream, among others.

They then strengthened their knowledge with further research and wrote journals on each attempt to make the products, with the aim of improving them each time they produced them. During the semester, they worked on production, marketing, costs, sales, and writing their research protocol.

The work has a phenomenological approach, understanding the meaning that people experience and give to their experiences; it is descriptive, as it specifies the properties, profiles, and characteristics of people and subjects them to analysis; it also generates or adjusts research questions through interpretation with non-numerical data collected, which is qualitative in nature [Hernández et al., 2011].

In the August-December 2024 semester, a teaching strategy was designed, based on project-based learning [PBL], with the aim of enhancing the critical thinking of first-semester students in the Public Accountant programme, as well as participation in the event leading up to Expociencias:

Developing technology-based and creative projects with scalability characteristics that encourage research and technological development capabilities in solving problems in the different public, social and private sectors at the local, regional and national levels, as well as strengthening innovation and entrepreneurship processes among participants [Tecnológico Nacional de México, 2025].

In the same vein, the objectives of Agenda 20-30, especially the fourth one on quality education, refer to 'by 2030, substantially increase the number of youth and adults who have relevant skills, especially technical and vocational skills, for employment, decent jobs and entrepreneurship' [United Nations, 2016, p.15].

Based on this proposal, a teaching strategy was designed based on the constructivist model 'knowledge is not copied from reality, but is actively constructed by the subject' [Piaget and Inhelder, 1973, p. 15] and project-based learning [PBL], as it is an active methodology that derives the importance of social interaction and relationships with other people in the development of human behaviour [Causil and Rodríguez, 2021].

The strategy was called 'Research Protocol towards Expociencias'.

The teaching strategy was applied in the August-December 2024 semester in the research fundamentals course, which has four units, the last part culminating in the submission of a research protocol.

The work process was as follows: Teams of a minimum of two and a maximum of five people were formed and asked to come up with a research idea for an innovative product made from raw materials from the region, which would then be marketed.

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To carry out the task, they researched the procedure for making the chosen product. Once they had consulted the steps, each time they made the product, they wrote in a journal about the progress or setbacks in production. Some teams sold something. Once they had finished developing the production process and presenting it, the experimental stage was over, and they continued with writing the protocol.

Part of the team devoted themselves to writing the research protocol for the presentation. To give an example, the first unit covers topics such as the relationship between man, knowledge and reality and the process of constructing science. This information was provided to link knowledge with the requested project. The second unit studies the tools of oral and written communication, which was therefore essential for the preparation and presentation of their final project.

The third part of the syllabus is the study of the development of their profession and its current state, in such a way that researching how a product can be made with raw materials from the region and then marketed is part of the economic activity that forms the profile of accountants, as well as having an impact on the 20-30 agenda. To conclude the process, the last unit is to write up the research process.

During the semester, a visit was made to the Natural Resources Research Centre, where staff from the institution provided information on the process of making products with raw materials from the region. The researcher who attended to them has extensive experience in this field and also attended to the teams individually who had questions and advised them on the production process for some of their products, including matcha yoghurt, banana jam, walnut cream, and dehydrated vegetables, among others.

The students implemented the recommendations and made changes to their products that significantly improved them.

6. Results

A teaching strategy was designed for the research fundamentals course, called ‘research protocol for Expociencias’;

A project was requested to be carried out during the semester, and the final protocol submission had to include a cover page, table of contents, problem statement, research question, objectives, justification, scope, theoretical framework, hypothesis [if applicable], methodology [approach, type of research, design, participants, project stages, product selection, cost and investment analysis, production and inventory control, marketing, accounting records, preparation of financial statements, logs, accounting records]; ethical considerations; timeline; necessary resources; references; appendices.

The final product should be submitted before the academic event takes place and presented to the judges on the day of the competition.

In accordance with what was requested in the strategy, critical thinking was part of the dynamic, according to Prieto, 2006, as cited in Causil and Rodríguez, 2021: the development of competencies in educational contexts involves identifying problems in the professional environment, becoming aware of one's own learning, planning learning strategies, as well as skills such as critical thinking, decision-making, self-directed learning, peer collaboration, evaluation and self-evaluation, conflict resolution, lifelong learning, and social skills [p. 23].

In addition, the student was the builder of their own knowledge by developing the entire strategy process. Eight teams presented very diverse proposals.

During the August-December 2024 school period, the reactions of the main actors were diverse, to mention a few: enthusiasm, investigative, denial, thinking that they would not achieve it, and the opposite, carrying out the idea and perfecting it each time. The team that made the banana jam sought advice from a nutritionist and a food chemical engineer to improve the product, and their perseverance and research work yielded favourable results, winning second place.

Similarly, the matcha yoghurt team bought milk from various producers until they found the one that best suited their product.

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The dehydrated fruit and vegetable team's first attempts were unsuccessful; they could not find the right balance for the proper presentation of their snacks, and at one point they wanted to give up.

The teacher's job was to convince them to continue with trial and error until they were satisfied. It is worth mentioning that this was one of the winning teams.

Likewise, the students who made the walnut cream took less time to produce their product than the previous teams, but it was very successful and they managed to sell it during the semester. On the other hand, there were some students who made vegetable gummies such as carrots and beetroot. This team had difficulties integrating with each other, but despite this, they managed to make the gummies, submit the protocol and enter the competition. Two teams made plates and paper by recycling notebook pages.

Both teams said that at first they only did it to fulfil the requirements, but as the semester progressed, they became attracted to the idea, although they did not have much time left to do a better job. Finally, the team that made charcoal from walnut shell waste was the winning team. They undoubtedly invested time in improving their product and researching and refining the production process.

In this intervention, the students were able to actively build their knowledge, enhance their critical thinking, and project-based learning made the class more dynamic and brought together knowledge from various subjects they were already studying and others they had yet to study, so they had to consult others in order to submit their reports. However, this was not an obstacle for them to overcome.

Critical thinking was evident in the students from the moment they generated the idea and carried it out, in addition to completing the entire process of development, costing, marketing, and documenting, as well as improving each time they made and documented the product's production process, when they presented and defended their product in front of the jury. The professional skills they developed were analysis, reflection, planning, decision-making, problem-solving, financial statement preparation, oral and written communication, teamwork, and leadership.

Some team members developed some skills more than others, but by the end of the semester, they had undoubtedly grown as students, individuals, and future professionals. When the competition ended, everyone looked very satisfied and proud, even though only a few teams won.

Each team was able to solve problems and work on the project, generating ideas and seeking support not only from their teacher but also from other people trained in what they set out to do, such as nutritionists, food chemical engineers, and doctors of science.

Likewise, the judges' logs in the evaluations of each team showed the professional and socio-emotional skills developed through collaborative work and the resolution of real problems.

7. Conclusions

The project-based teaching strategy in this study helped students to enhance their critical thinking and generated ideas for creating micro-enterprises based on products from the region.

Furthermore, subjects that university students perceive as filler and boring can be presented in a way that challenges them to present solutions to problems or generate businesses that can help them in their way of life and help them attract the attention and collaborative work of students and generate professional and life skills in each participant, encouraging analysis and problem solving. In addition to the above, the students generated a business idea using raw materials from the region to transform and market them.

8. Contributions

The teaching strategy implemented in the research fundamentals course was well received by the students. The course was conducted in a very dynamic manner, with results that generated academic knowledge and professional and everyday skills.

In addition, they had the experience of creating a micro-enterprise, with a product made from local raw materials and strategies for its commercialisation. It is hoped that this can be implemented in the next semester.

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Anexos

Box 1

Figure 1
Présentation finale des projets
Source : Propre

Declarations

Conflicts of interest

The authors declare that they have no conflicts of interest. They have no competing financial interests or known personal relationships that could have influenced the article presented in this paper.

Contribution of authors

Ahumada-Maldonado, Blanca Irene: Contributed to the generation of the project idea and was a teacher in the research group in which the work was carried out.

Ogaz-Vasquez, Alba Jyassu: Collaborated in the search for information, conceptual and methodological development of the research, and analysis of the results obtained.

Valle-López, César Iván: Collaborated in the organisation of the closing event, the creation of the jury's logs, and the interpretation and analysis of the results obtained.

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Antecedentes

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